4.1.8. STRATOSPHERIC AEROSOLS

The MLO lidar measurements of aerosol backscatter and stratospheric/mesospheric temperature continued during 2000 and 2001. The frequency of measurements was about 42 per year, similar to previous years. The record of MLO total stratospheric integrated aerosol backscatter since 1999 is shown in Figure 4.11, along with the record from the Boulder lidar. The same background levels and annual cycle continued and were summarized by *Barnes and Hofmann* [2001]. No aerosol increases from volcanic eruptions were identified.

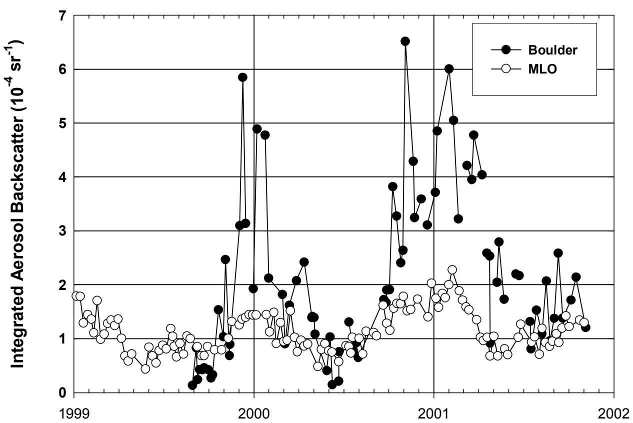

Fig. 4.11. Lidar measurements of integrated aerosol backscatter (IABS) for the stratosphere. At MLO the altitude range is 15.8 to 33 km; in Boulder the range is tropopause to 30 km.

The Boulder lidar was installed in 1999 and operated with a single detector channel for all altitudes. Because of the high-altitude variability of the tropopause, measuring the stratosphere proved to be a problem for the single channel, and a second detector was added and optimized for the troposphere in April 2000. Several Asian dust episodes were measured with this channel in spring 2001. The Boulder data show much more variability than the MLO data. The annual cycle of stratospheric aerosol above Boulder is in phase with that of MLO, peaking in the winter, but has a much larger amplitude. Much of the winter increase in the stratospheric aerosol layer above Boulder is due to the lowering of the tropopause height (from 15 km in summer to 10 km in winter). A stratospheric layer is much harder to identify above Boulder where there are often larger aerosol concentrations in the upper troposphere than in the stratosphere. The tropopause height at MLO (16 km in summer and 17.5 km in winter) varies much less than that of Boulder, and the MLO stratospheric layer is always clearly defined because the upper troposphere generally has very small aerosol concentrations. The variability of the peak scattering ratio is larger at Boulder than at MLO (Figure 4.12). The peak ratio is usually several kilometers above the tropopause and may be a better quantity than the integrated aerosol backscatter (IABS) for comparison of MLO and Boulder data.

Work for a NOAA grant to make the ruby lidar stratospheric aerosol record available to researchers was completed in 2001. The entire record since 1974 was standardized and error estimates were included in the data files. The observations are now available by anonymous ftp to the public (mloftp.mlo.noaa.gov). Part of the work was completed by a local high school science teacher and high school student.

One new measurement added to the MLO lidar was water vapor. The Raman-shifted wavelength due to water molecules was measured to obtain profiles from the station altitude to approximately 14 km. The lidar is able to reach altitudes above that of radiosondes, and also measure aerosols simultaneously, which is useful for cirrus cloud studies. A National Aeronautics and Space Administration (NASA)-funded program will use the lidar and sondes to validate water vapor, temperature, and ozone for the Atmospheric Infrared Sounder (AIRS) satellite instrument to be launched in 2002. The measurement of water vapor profiles by lidar is limited by the weak signal in the cold, dry upper troposphere. New red-sensitive detectors and a new 74-cm-diameter mirror were installed to increase the water vapor signal. The optical support structure was extended to accommodate the long focal length of the new mirror. The old ruby telescope was remounted at the same time to test new components.

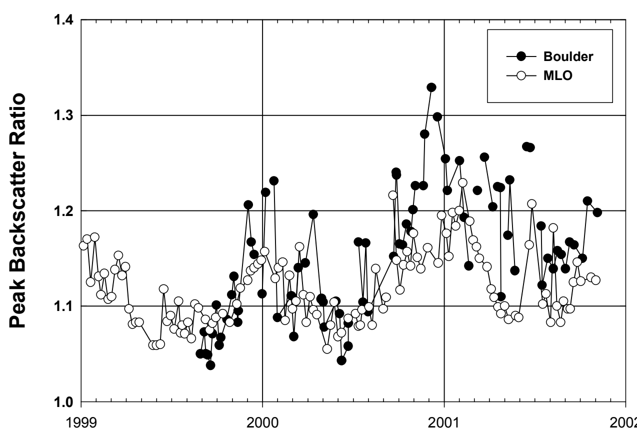

Fig. 4.12. Lidar measurements of peak aerosol backscatter ratio for the stratosphere. The backscatter ratio is the total scattering (molecular + aerosol) divided by the molecular scattering. A ratio of 1.0 is pure molecular scattering.